another taken at the Lick Observatory in 1913; also in a photograph taken at Allegheny at Mr. Hubble's request. The most striking change was what at first appeared to be a transverse shift of a bright patch just north of the nucleus, but further examination suggested that this was more probably due to the sudden appearance of a mass of bright nebulosity. There are several other differences between the photographs which appear to be due to real changes in the nebula. In particular, a small mass a little south-east of the nucleus exhibits a decided irregular movement, having moved in towards the nucleus when the above-mentioned new mass appeared. This small mass moved not less than $0{\cdot}5''$ per year between 1908 and 1913, and it seems likely to have a measurable parallax.

Rotation of the entire nebula would not account for the variations observed, but some of the changes may be explained by local brightening and fading of stationary matter. Actual motion of portions of nebulosity relative to the nebula as a whole, however, is regarded by Mr. Hubble as the probable explanation of most of the changes observed. The spectrum of the nebula has been found to be continuous.

THE STRUCTURE OF THE RED LITHIUM LINE.—The complex structure of the red line of lithium, λ 6708, has been further investigated by Dr. A. S. King at the Passadena Laboratory (*Astrophysical Journal*, vol. xliv., p. 172). It is shown that the line may appear with two distinct sets of components, either as an unsymmetrical doublet, or as a triplet of variable separation. In a third stage the side components of the triplet change into an ordinary reversal within which the central component can still be seen. All three conditions of the line may be produced either in the arc or electric furnace, and the controlling agency appears to be the amount of vapour in the source. The variable interval of the components suggests an electrical resolution, which would most likely be due to the action of interatomic fields. The observations have proved that the line at 6708 which commonly appears in calcium spectra is due to lithium impurity. Also, it may now be considered certain that the strong line appearing at this position in the spectra of sun-spots should be attributed to lithium. It is remarkable that this should be the only direct proof of the presence of lithium in the sun, there being no representatives of this element in the Fraunhofer spectrum.

PLANTATION RUBBER.

THE *Trade Supplement* of the *Times* for December is devoted almost entirely to plantation rubber. The editor has drawn upon some of the best authorities in the plantation world for his contributions, and without exaggeration has achieved a pronounced success. The articles deal with the development of the plantation rubber industry throughout the Middle East, the physical, biological, and chemical problems involved in the preparation of the raw material, and the importance of the supplies to the manufacturing industry in this and every other country.

The large number of contributors has resulted in repetition of the same facts, but this was scarcely avoidable in such an issue. Much of the information has already been disseminated in text-books and technical journals, but the matter has been rendered in this supplement in a form which will appeal to all interested in the industry either financially or technically.

In one of the most important articles Prof. J. Bretland Farmer outlines the risks of tropical agriculture, the efforts which have been made by Government and private individuals, and the need for still greater precaution and the placing of the industry on a better scientific foundation. It is already known that the Imperial College of Science has sent a number of scientific officers to the Middle East, and we know from personal contact with them that they have felt the necessity of periodically spending a part of their time in first-rate laboratories in Europe or America. It is impossible for the scientific officers in charge of plantations in the Middle East to be conversant with all the advances made in plant sanitation, biological problems, and testing apparatus of value to the plantation industry

A brief survey of the article on "Pests and Diseases," by Mr. J. Mitchell, satisfies one that there is every reason why the many diseases affecting the roots, bark, stems, and fruits of *Hevea brasiliensis* should be carefully watched. The necessity for independent scientific officers to be put in charge of such work is quite apparent even to the ordinary investor, who has but little knowledge of mycological and entomological problems

With regard to the physical and chemical researches in the laboratories of the manufacturers, some very useful information is contributed by Mr. W. A. Williams, Dr. Joseph Torrey, and Dr. Philip Schidrowitz. There is a great lack of uniformity in cultivated rubber, which materially affects processes of manufacture and the finished article. It is suggested that the difficulties consequent on variation of plantation rubber can be reduced by standardisation of methods of preparation on the estate and by closer co-operation with manufacturers in this country. The lack of co-operation between plantation growers and manufacturers is emphasised by Mr. Alexander Johnston.

A review of this supplement cannot be completed without reference to the very strong article by Mr. E. Stevenson, chairman of the Rubber Trade Association of London. Mr. Stevenson points out the absolute need of organisation, and shows that the growers themselves are very largely responsible for the competitive system which they have set up. Organisation is apparently as necessary among producers, manufacturers, and dealers in raw rubber as it is on the plantations, and the supplement before us will serve a good purpose if it results in any definite advances being made in this direction. H. W.

MARINE ISOPODA FROM THE NORTH ATLANTIC.[1]

THE papers before us form two of the valuable series of reports now being issued by the Danish Government, through the Zoological Museum at Copenhagen, on the results of the exploration of the deep sea in the neighbourhood of Greenland, Iceland and the Faröes. They constitute a monograph of the Isopoda and Tanaidacea of that region, and their importance may be judged from the fact that, whereas previously only fifty-three species of Isopoda were known from the area surveyed, Dr. Hansen records 242 species, of which 125 are described for the first time, and establishes eighteen new genera. This satisfactory result is due to the methods of collecting introduced by the author during the expedition. The mud brought up in the trawl and dredge was carefully sifted through fine bolting silk, and the results of the sifting preserved for future examination. In this way hundreds of small animals, which could not have been collected by any other means, were discovered. This method may be recommended to naturalists in charge of future expeditions for the ex-

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[1] "The Danish *Ingolf*-Expedition." Vol. iii., No. 3, "Crustacea Malacostraca," II. By H. J. Hansen. Pp. 145+12 plates. (1913.)

"The Danish *Ingolf*-Expedition." Vol. iii., No. 5, "Crustacea Malacostraca," III. Pp. 262+16 plates (Copenhagen: Printed by Bianco Luno, 1919.)

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ploration of the deep-sea fauna. We can speak from personal experience of the efficacy of a modification of Dr. Hansen's methods which has been used with great success in the exploration of the deep water to the west of Ireland, where the use of fine silk tow-nets attached to the dredge and trawl has revealed a wealth of species undreamt of by earlier British marine biologists.

Dr. Hansen prefaces his reports by a critical account of the literature relative to the area surveyed by the *Ingolf*, and a valuable summary of the geographical and bathymetric distribution of the species in the collection.

Of special interest is his conclusion that the Wyville-Thomson ridge does not form an absolute line of separation between the deep-sea fauna of the cold and warm areas. Evidence is submitted of several species which have been found in both areas, and the author rejects the hitherto accepted explanation of this distribution, that these species were taken pelagically and not actually on the bottom.

Dr. Hansen has a valuable chapter on sexual differences among Tanaidæ, in which he comments on the rarity of adult males, and makes the interesting suggestion that the development of the marsupium and eggs in the female is accompanied by a reduction in size. His remarks on the nomenclature of segments and joints and on generic and specific characters in Tanaids will prove of the utmost service to students of this difficult order of Crustacea, which is marked by great uniformity of external form and the absence of tangible characters upon which species and genera may be distinguished.

The most important morphological feature brought forward in these reports is the evidence in favour of the author's theory, advanced some twenty-three years ago, that the sympod of all biramous appendages in Crustacea was primarily three-jointed. Hitherto no evidence in support of his case could be brought forward as regards the thoracic limbs of the Malacostraca (with the exception of Nebalia), but Dr. Hansen has now produced evidence of the existence of a præcoxal joint in the maxillipeds of two species of Isopoda.

The new species and genera are clearly described and illustrated by a series of beautifully drawn figures. The wealth of material at the disposal of the writer and his clear and critical insight into the true value of characters for systematic purposes have led him to suggest several modifications in the minor classification of the families and genera of Isopoda, which tend to a better understanding of the group and to a restoration of order out of the chaos into which it was rapidly falling.

Students of Arthropoda have been indebted to Dr. Hansen in the past for a series of illuminating papers elucidating the structure and classification of many obscure and difficult groups. Their obligations are considerably increased by the publication of these valuable papers, which workers on Isopoda will find indispensable to the successful prosecution of their studies.

W. M. T.

GROWTH FACTORS OF FOODS.

THE *Biochemical Journal* more than maintains its increasing and well-deserved reputation in the current number (vol. x., No. 3). The articles of most general interest are two on feeding experiments, which were carried out at the Cambridge Biochemical Laboratory under Prof. F. G. Hopkins's direction. These experiments are a continuation of the very careful and elaborate series which Prof. Hopkins has been making for several years past upon the growth factors of foods. In all of them young albino rats of uniform origin, sex, and weight are employed. They are fed and treated in an exactly similar manner, except with regard to the essential factor with which the investigation is concerned. The food consists of starch, cane-sugar, fat, suitable salts, and various protein products, together with the alcoholic extract of 1·5 c.c. of milk per diem, as this extract contains an unknown "vitamine," which is absolutely essential for the normal growth of the rats. In the first series of experiments, carried out by G. Totani, it was found that rats fed on the hydrolysed products of caseinogen from which all but 0·2 per cent. of the tyrosine had been removed, and to which a small quantity of tryptophane had been added, grew just as rapidly as on a similar diet to which tyrosine was added in addition. Other experiments made with a diet of hydrolysed gelatin—which contains no tyrosine or tryptophane—showed that whilst the rats lost 18 per cent. in weight in a month, they lost little, if any, weight if tryptophane were added. The addition of tyrosine as well was without influence, and so it seems highly probable that the tissues of the mammal have the power of synthesising tyrosine. They form it from phenylalanine, but the small amount of this substance present in gelatin suggests the possibility that they can synthesise the benzene ring from non-aromatic substances.

The second series of experiments relates to the synthesis of tryptophane in the body. It is known that some of the tryptophane of the food is excreted in the urine in the form of a quinoline derivative, kynurenic acid, and C. Asayama investigated the capacity of the tissues to carry out the reverse change. He found that rats fed on the amino-acids formed by the prolonged acid hydrolysis of caseinogen—a treatment which destroys all the tryptophane originally present—rapidly lost weight and died in eight weeks, though they grew moderately if tryptophane were added. If kynurenic acid were substituted for the tryptophane they lost weight and died at almost exactly the same rate as when no kynurenic acid was added at all, so we must conclude that whatever the synthetic powers of the tissues for tryptophane may be, they do not extend to this substance.

EDUCATIONAL REFORM.

THE Education Reform Council, which was founded last April at a conference called by the Teachers' Guild, has issued a programme of education reform. The work of the council is as yet incomplete, and it is hoped to publish the full report early next year. Among other important recommendations enumerated in the programme the following deserve special mention. The Ministry of Education should hold a higher place in the hierarchy of the offices of the State, and the salary of the Minister should be equivalent to that of other principal Secretaries of State. Progressive organisation is hindered by certain statutory distinctions between higher and elementary education. Local authorities for higher education should be obliged to supply or aid the supply of higher education, and the limit of 2*d*. to the higher education rate in the county areas should be removed. For the purpose of co-ordinating the activities of local education authorities with those of the universities and institutions for higher education, the country should be divided into educational provinces, the areas of which should be larger than those of the existing local authorities.

The number of efficient secondary schools of varying types should be increased. The Consultative Committee has advised the strengthening of the higher work of secondary schools, and the Reform Council considers that schools taking the lower grant should receive grants for this purpose. Pupils at any school

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